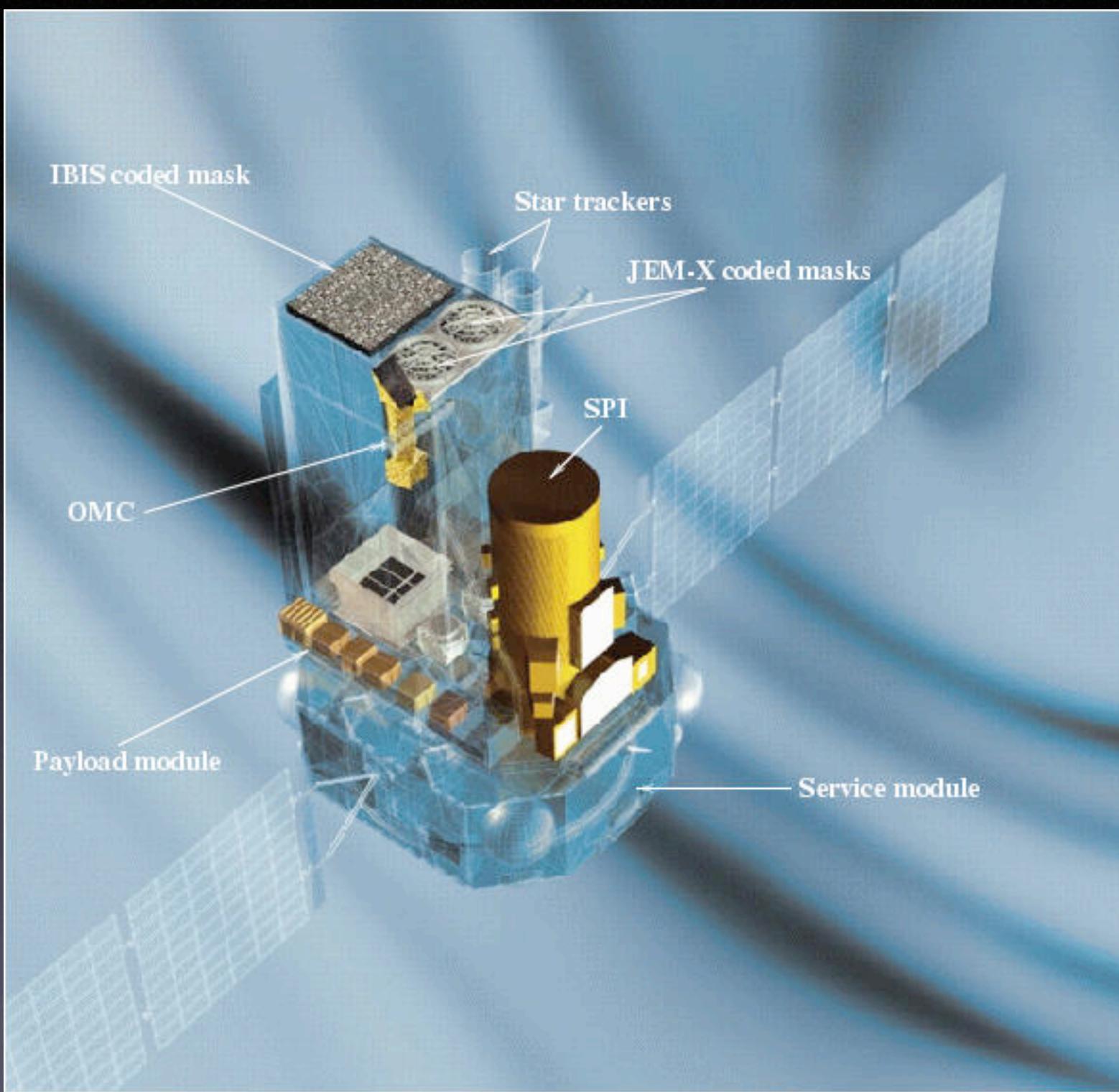


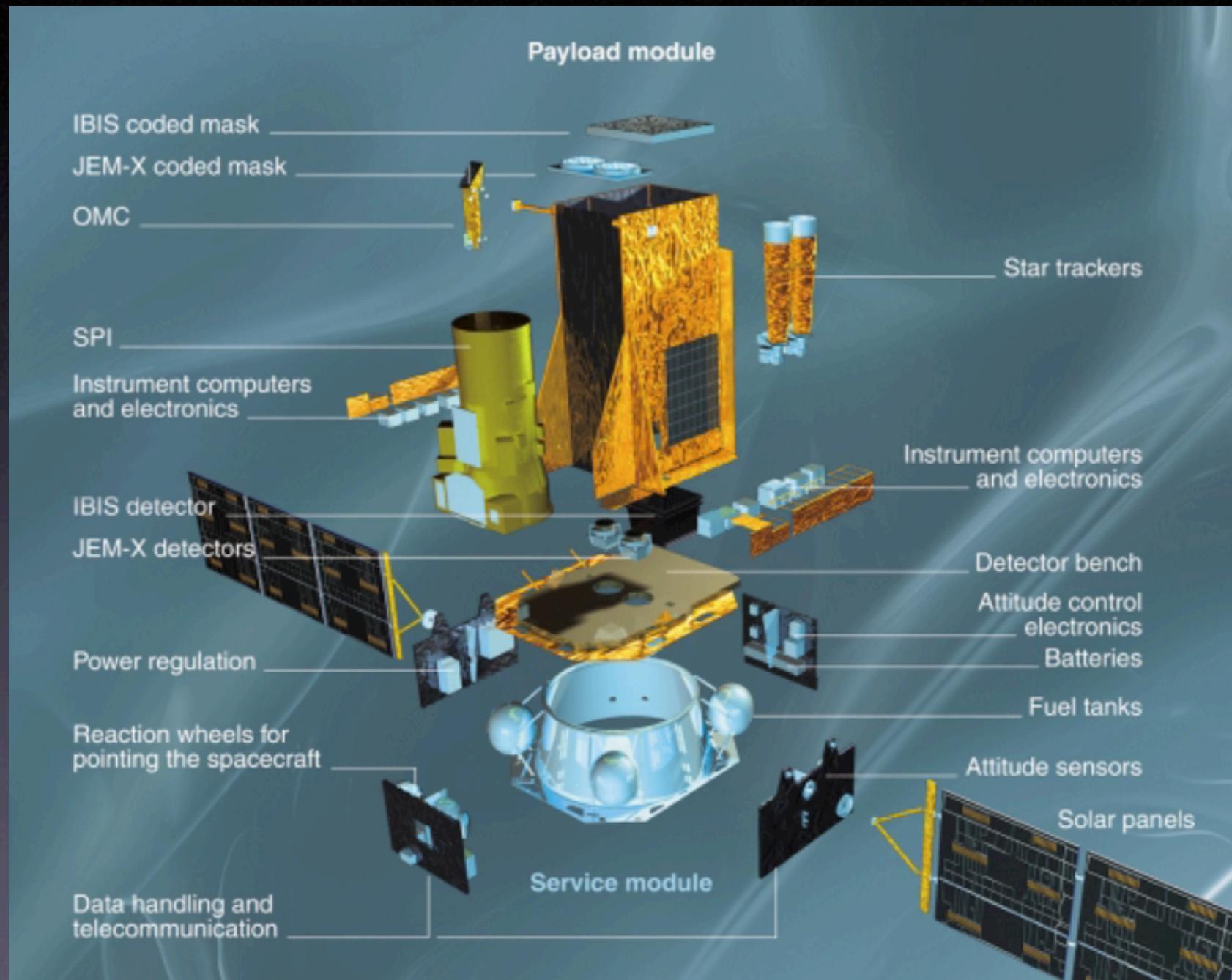


Observing
the X and Gamma-ray sky
with
INTEGRAL

Science objectives

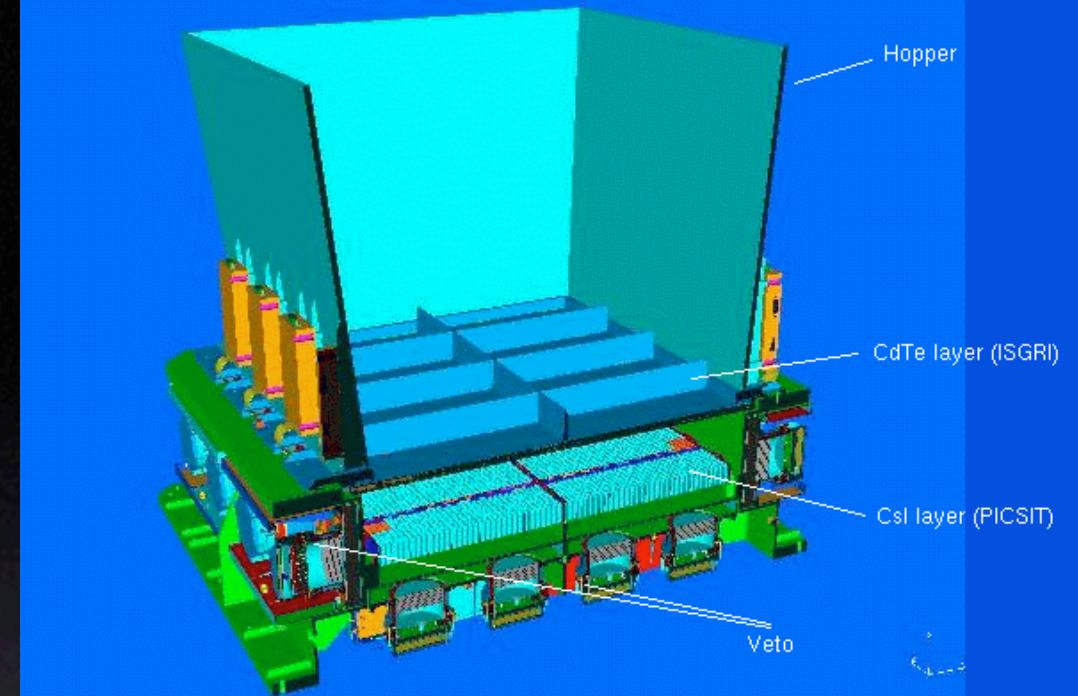
- observe the universe in the 3 keV-10 MeV band
- Stellar nucleosynthesis
 - detection, mapping and high res. spectroscopy of recent supernovae, supernova remnants, novae...
 - mapping of nuclear lines emission in the galaxy
 ^{22}Ti , ^{22}Na , ^{26}Al , ^{60}Fe , 511 keV e+e- annihilation lines
- Physics of compact objects: pulsars, neutron stars and black holes in X-ray binaries, supermassive black holes in AGNs...
- Detection and localization of Gamma-ray bursts





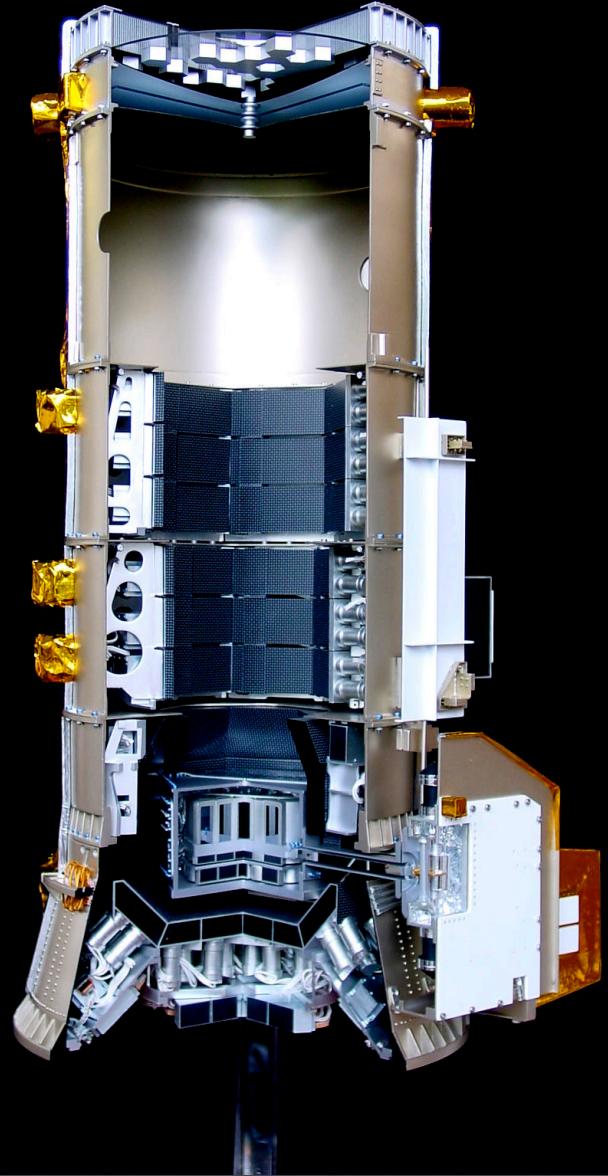
IBIS

- Energy range: 15 keV-10 MeV (22-400 keV)
- Detector area: 2600 cm^2 (CdTe), 3000 cm^2 (CsI)
- Angular resolution: 12' FWHM
- Source localization @100 keV: 3' (3 sigma) 30" (50 sigma)
- Spectral resolution: 8 % @ 100 keV, 10 % @ 1 MeV
- FOV: 8.3×8 deg fully coded
- Line sensitivity @100 keV, 3 sigma in 10^6 s: $1.8\text{e-}5 \text{ ph}/(\text{s cm}^2)$
- Continuum sensitivity @100 keV, 3 sigma in 10^5 s: $2.3\text{e-}6 \text{ ph}/(\text{s cm}^2 \text{ keV})$



SPI

- Energy range: 18 keV-8 MeV (20 keV- 2MeV)
- Detector area: 500 cm^2 (Ge)
- Angular resolution: 2.5 deg FWHM
- Spectral resolution: 2% @ 1 MeV
- FOV: 16 deg (corner to corner) fully coded
- Line sensitivity @ 1 MeV, 3 sigma in 10^6 s: $2.4\text{e-}5 \text{ ph}/(\text{s cm}^2)$
- Continuum sensitivity @ 1 MeV, 3 sigma in 10^6 s: $8.8\text{e-}4 \text{ ph}/(\text{s cm}^2 \text{ MeV})$



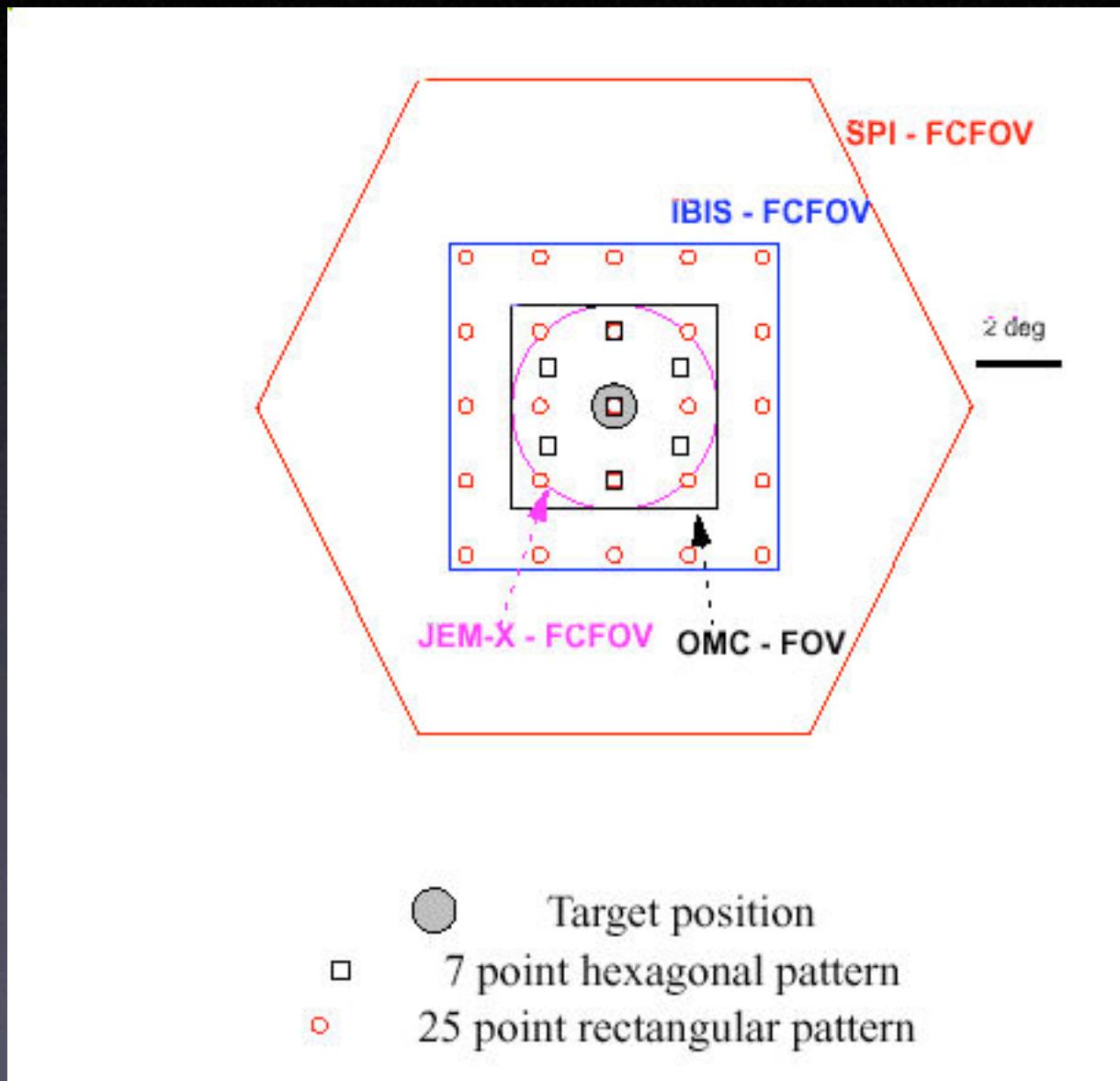
JEM-X

- Energy range: 3-35 keV (3-25 keV)
- Detector area: 500 cm^2 (1 unit)
- Angular resolution: 3' FWHM
- Spectral resolution: 13% @ 10 keV
- FOV: 4.8 deg (corner to corner) fully coded (smaller than prime instruments)
- Line sensitivity @ 6 keV, 3 sigma in 10^5 s: $1.6\text{e-}4 \text{ ph}/(\text{s cm}^2)$
- Continuum sensitivity @ 6 keV, 3 sigma in 10^5 s: $1.2\text{e-}4 \text{ ph}/(\text{s cm}^2 \text{ keV})$
- Continuum sensitivity @ 6 keV, 3 sigma in 10^5 s: $1.2\text{e-}4 \text{ ph}/(\text{s cm}^2 \text{ keV})$

Optical Monitor

- Wavelength range: 500-600 nm (V band)
- Detector: 50 mm lens + CCD (2055x1056 pixels), imaging area 1024 x 1024 pixels
- Angular resolution: 23" (often source confusion in the Galactic plane)
- FOV: 5x5 deg
- Sensitivity 3 sigma in 2000 s: 18.1 mag (v) (only one source)
- Source location accuracy: 6"

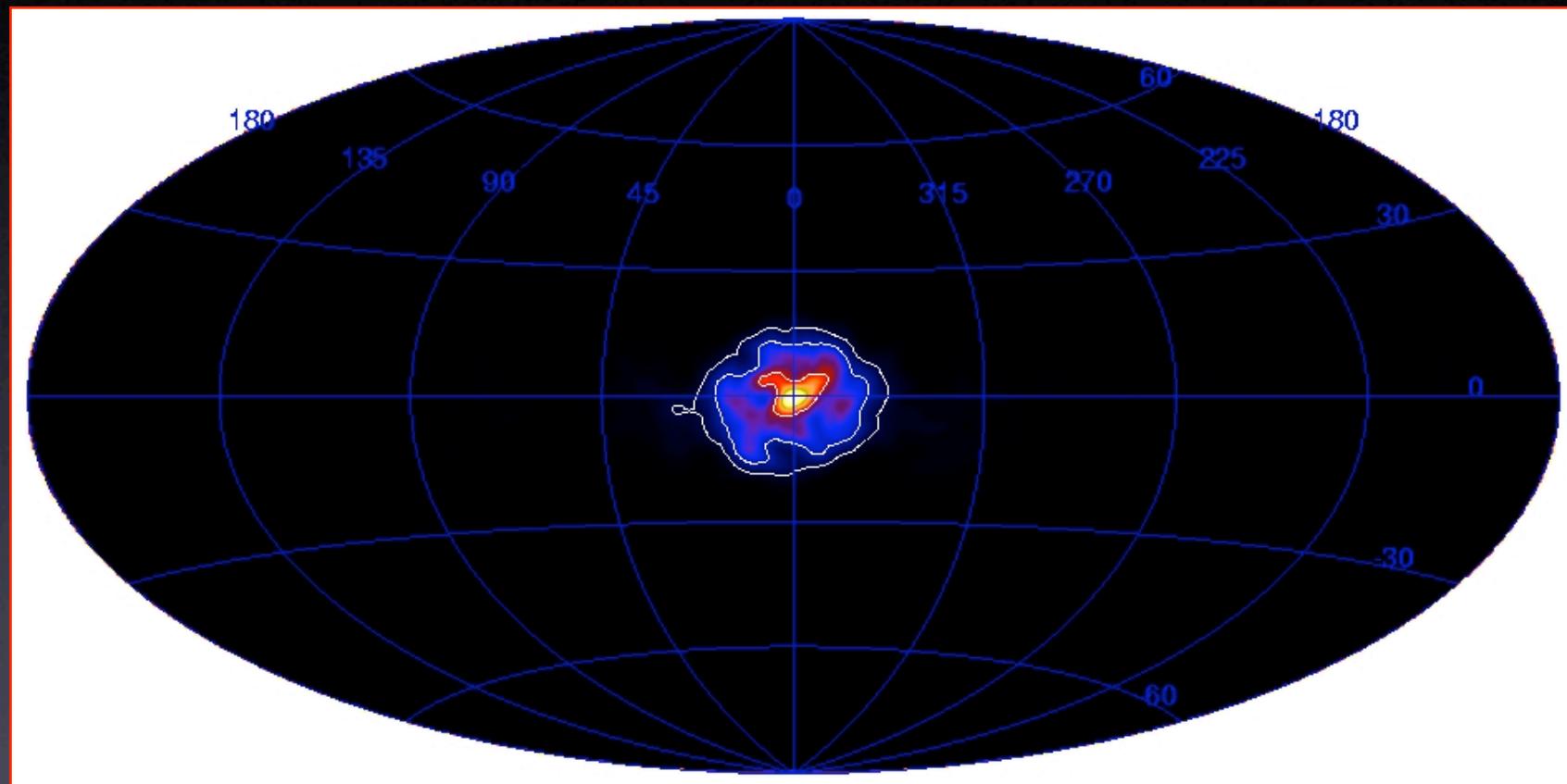
Dithering modes



Observing programme

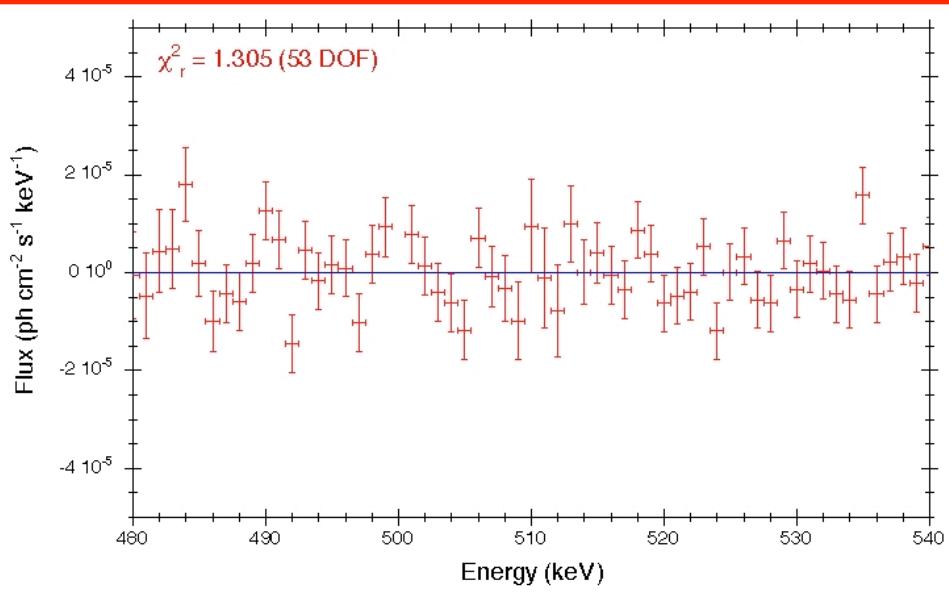
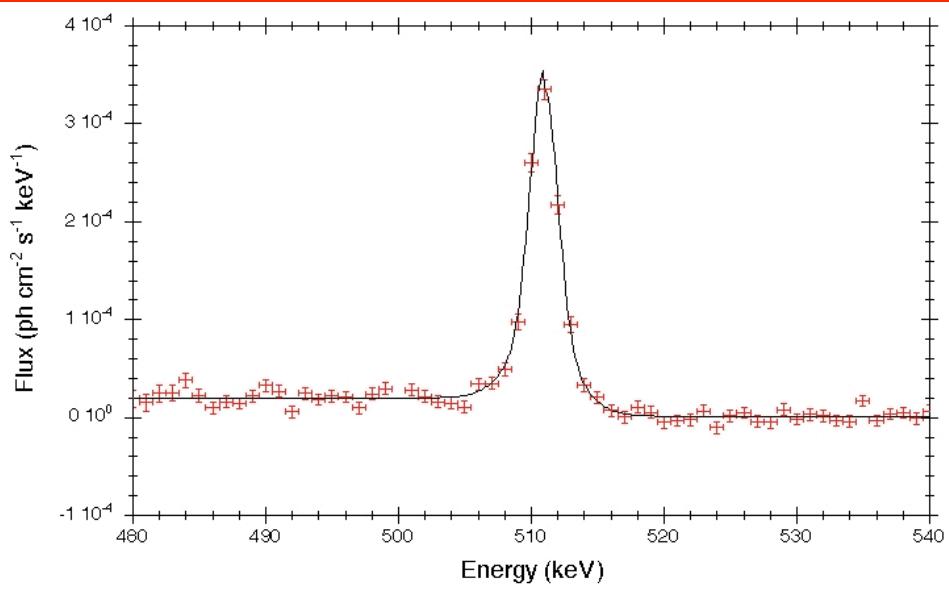
- 75 % of observing time is open to guest observers
(next AO 4 deadline on 21 April 2006)
- Core programme
 - Galactic center deep exposure
 - scan of the galactic plane, search for transient sources
 - Targets of opportunity
- All data are public after 1 year

SPI/INTEGRAL image of 511 keV emission in the galaxy



Knödlseder et al. A&A , 2005

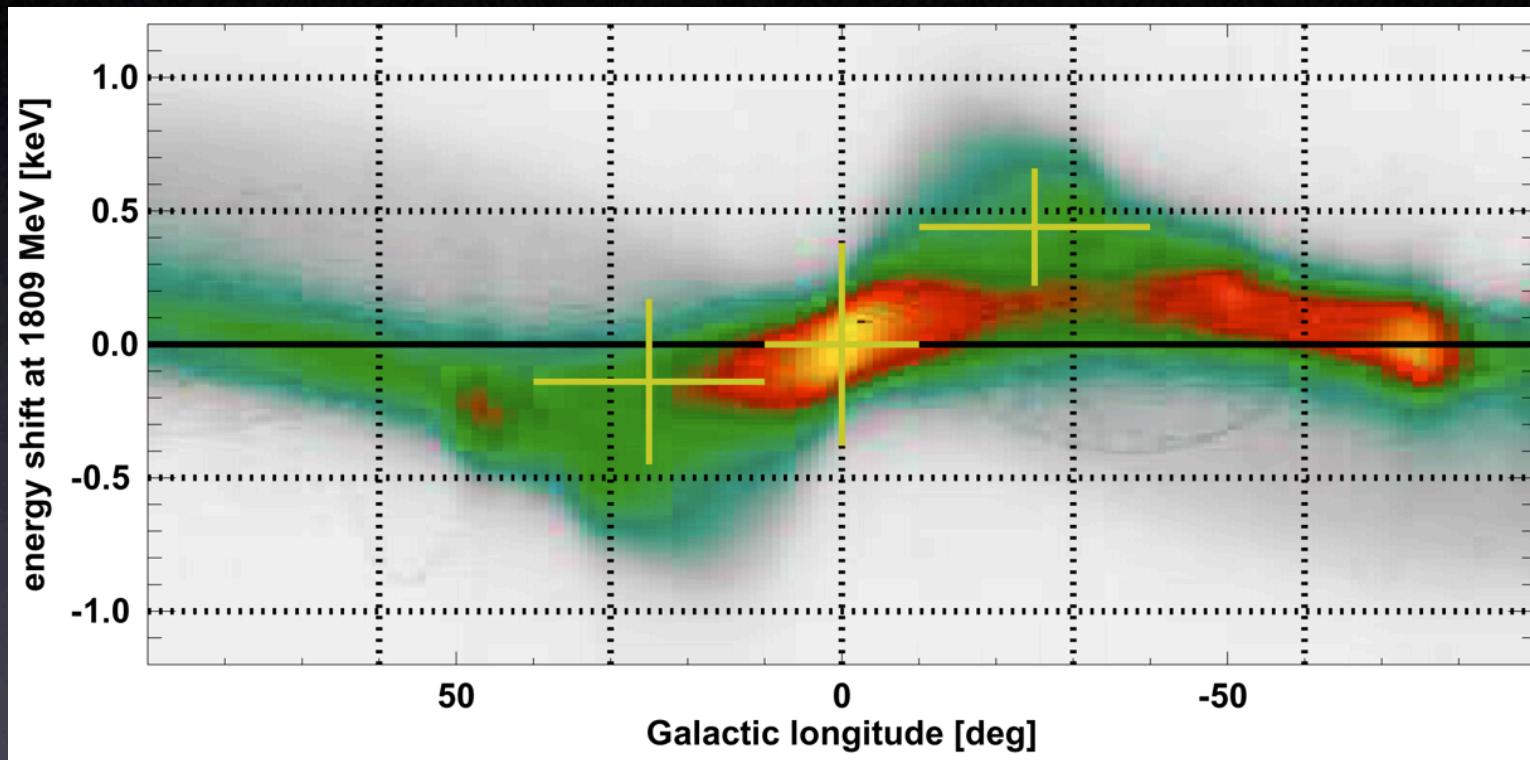
Galactic bulge spectrum



Churazov et al. 2005;
Jean et al. 2006

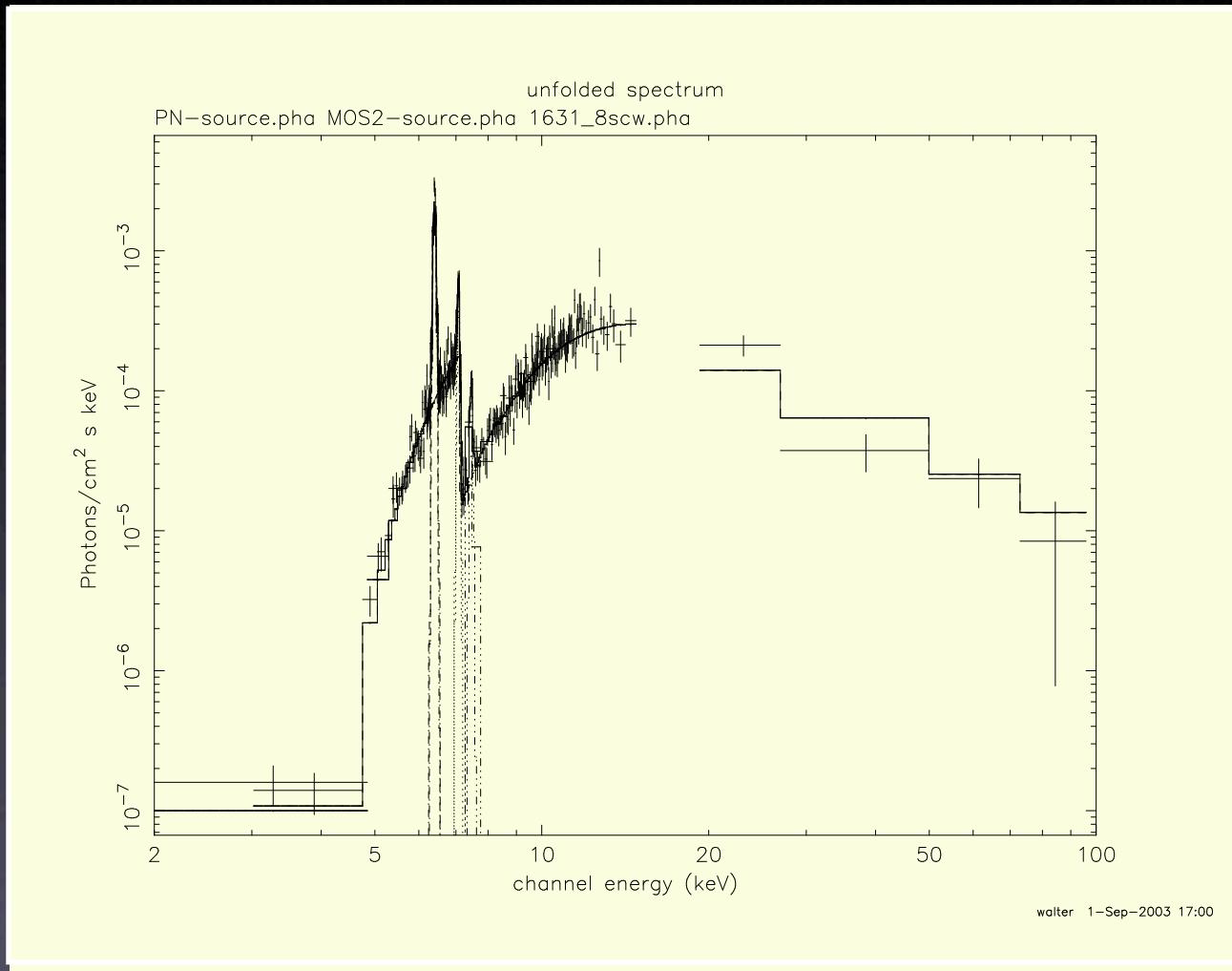
- Model : 2 Gauss + positronium + continuum.
 - Energy 510.98 ± 0.03 keV
 - FWHM1 1.14 ± 0.40 keV
 - FWHM2 5.08 ± 1.11 keV
 - Flux1 6.9×10^{-4} ph cm⁻² s⁻¹
 - Flux2 3.8×10^{-4} ph cm⁻² s⁻¹
- Narrow Gauss (FWHM = 1.1 keV):
 - ~65 %
 - Thermalised positrons
- Broad Gauss (FWHM = 5.1 keV):
 - ~35 %
 - Inflight positronium formation (quenched if fully ionised)
- Consistent with 8000 K ISM with ionisation fraction of 0.07 -0.17

^{26}Al signature of galaxy rotation



Diehl et al., Nature, 2006

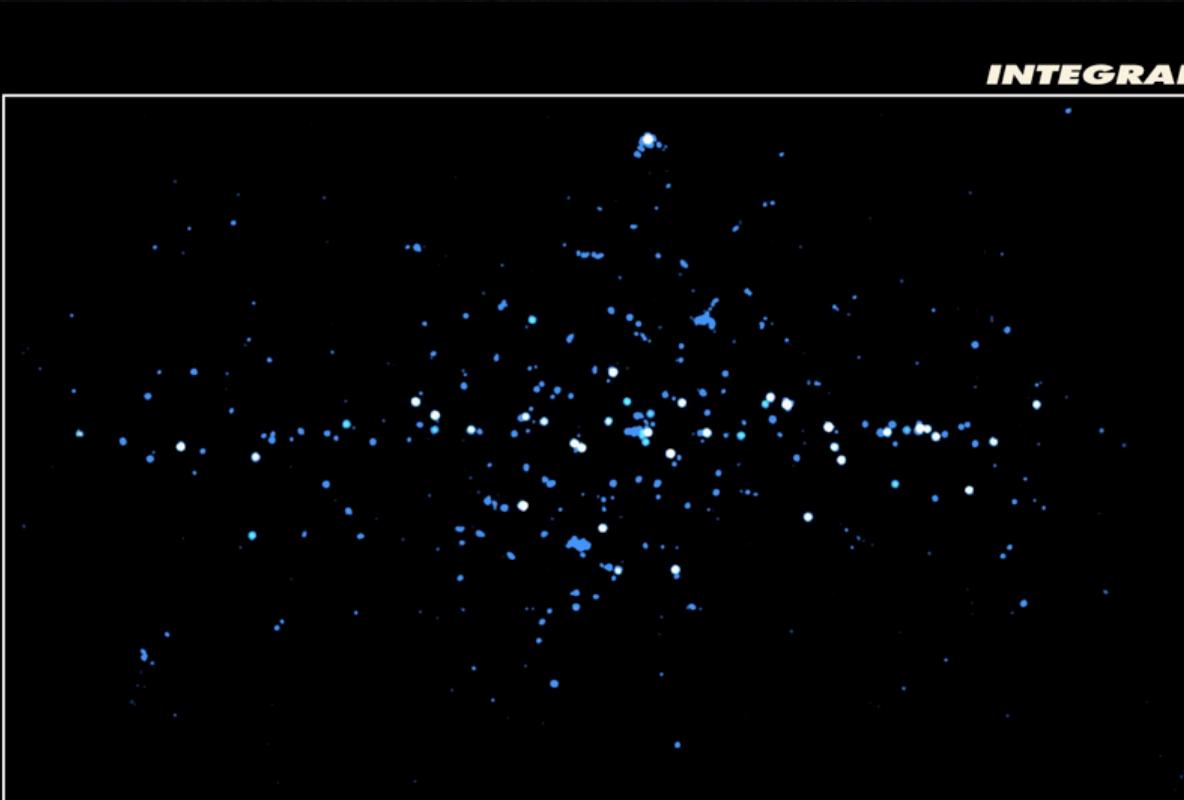
Discovery of highly obscured X-ray binaries



- ~13 obscured high mass X-ray binaries
- see presentation by Arash Bodaghee

Walter et al., 2003

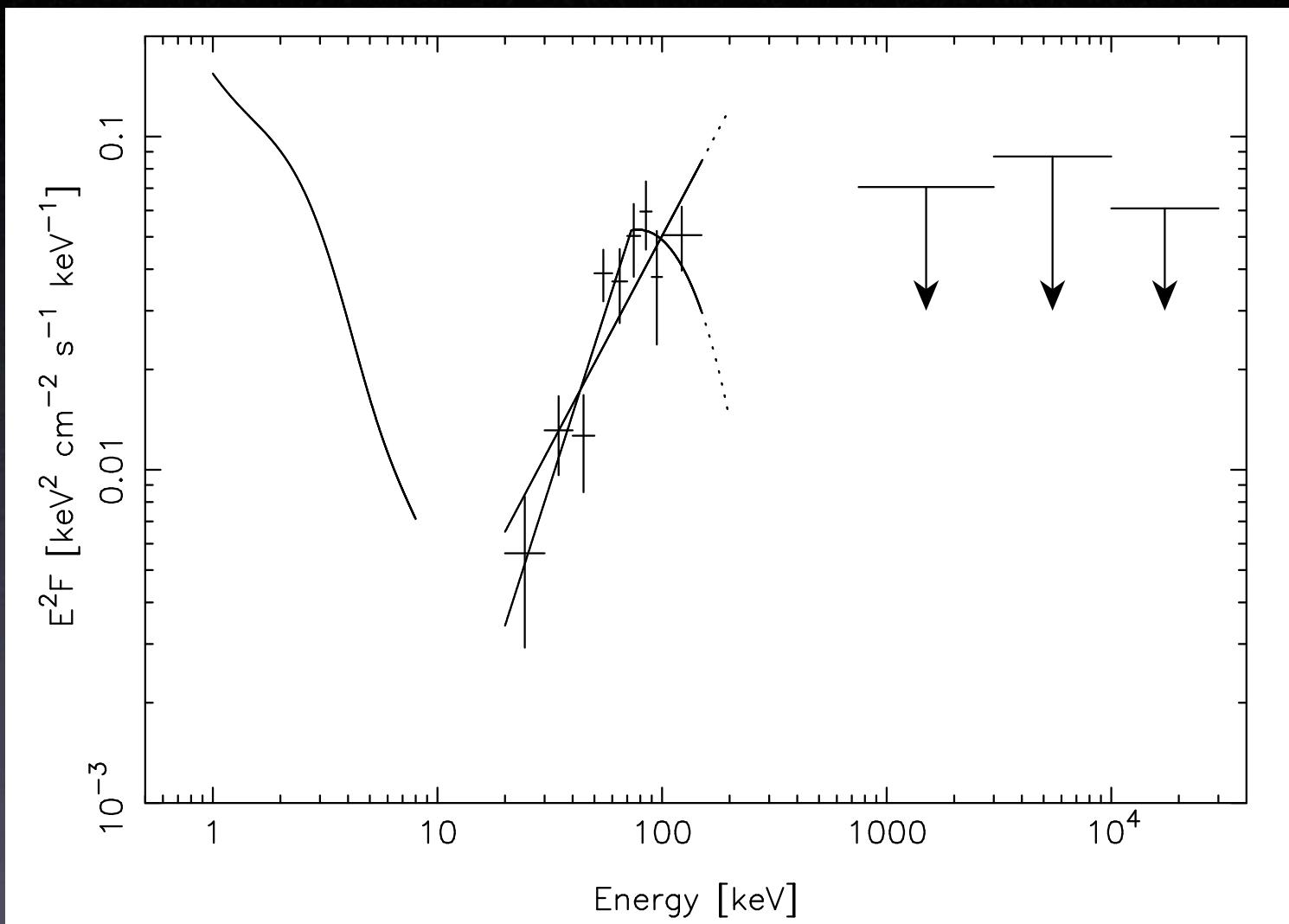
Soft Gamma-ray emission from the galactic center region resolved



- discovery of 91 new gamma-ray sources responsible for 90% of the emission

Lebrun et al., Nature, 2004

Discovery of high energy emission in Anomalous X-ray Pulsars (AXPs)



Den Hartog et al., 2006

see lecture by Wim Hermsen (...and M.Tagger for the MHD)

For more information:

- <http://integral.esac.esa.int>
(submit proposals before 21st april)
- <http://isdc.unige.ch>
(data analysis)
- <http://isdc.unige.ch/~rodrigue>
(picture of Jérôme + info on IGR sources)
- <http://heasarc.gsfc.nasa.gov/docs/integral/integralgof.html>
(light curves, images in fits and jpeg format)